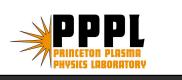


IEA/ESE-FP TASK 5 MEETING PRINCETON PLASMA PHYSICS LABORATORY OCTOBER 10, 2003

TFTR Safety Analysis Process

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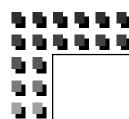




- PURPOSE: TO DEMONSTRATE THAT TFTR OBJECTIVES COULD BE MET WITHOUT UNDUE RISKS TO HEALTH & SAFETY OF OPERATING PERSONNEL & GENERAL PUBLIC.
- TWO-STAGE PROCESS FOR TFTR FIRST PLASMA: PSAR & FSAR.
- **◆ PSAR DEVELOPED IN 1976-7; APPROVED BY DOE IN 1978.**
- FSAR DEVELOPED 1980-82; APPROVED BY DOE IN 1982.
- ◆ FSAR AMENDMENT #2 FOR D-T OPERATIONS IN 1992. BECAME PART OF TFTR D-T AUTHORIZATION BASIS.

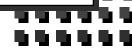


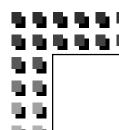




- Preliminary Safety Analysis Report (PSAR)
 - DOE guidelines on format & content were unavailable. Used NRC guide for nuclear power plant SARs. Deterministic FMEAs; minimal probabilistic analyses.
 - Two volumes, 1000 pages.
 - Radiological Hazards
 - Assure that design objectives could be met
 - 7 mrem/yr at site boundary for routine operations
 - "Worst case accident": collapse of test cell with maximum tritium inventories in torus, NBLs, injection volumes - 2730 mrem (6100 Ci HTO).
 - Dose calculations based on conservative gaussian models derived from NRC licensing documents (no site specific measurements)
 - Natural Phenomena
 - Most Intense earthquake/tornado design for high tritium SSCs (Tritium Storage Area) - 0.13g, 245 mph
 - Most Probable earthquake/tornado design for other experimental area SSCs - 0.07g, 110 mph.
 - 300 DOE review comments; 5 months to resolve.

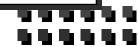


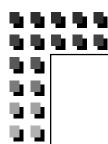




- Final Safety Analysis Report (FSAR)
 - For approval to achieve first plasma (December 1982)
 - 3 year effort
 - Same format as PSAR
 - Upgraded PSAR descriptions, and refined potential accident scenarios and their consequences.
 - Used site specific meteorology as input to dose calculations
 - "Worst case" accident consequences: 660 mrem (14,600 Ci HTO).
 - 300 comments; 5 months to resolve
 - Received separate comments from individual DOE entities as they were generated & prior to receiving all comments in one package; expedited approval process.







- Nine (9) FSAR amendments were prepared from 1988-2000.
- ◆ Large effort for Amendment 2 to seek approval to commence D-T experiments. More emphasis on probabilistic analyses. A detailed probabilistic risk assessment of potential tritium releases from TFTR was done by an independent consultant.
- ◆ Three (3) year effort (1990-92); 400 DOE comments. Reflected increased ES&H attention & DOE nuclear safety rules.
- Applied results of site specific climatology study by NOAA in 1988.
- "Worst case accident": pipe break causes air ingress to tritium storage bed, 25,000 Ci HTO stack release, 140 mrem maximum offsite dose.
- ◆ Looked at "beyond worst case" event where HVAC also fails, causing 25 kCi ground level release, 390 mrem maximum offsite dose.







AUTHORIZATION BASIS

- Collection of documents constituting agreements between DOE and DOE nuclear facility operators for safely operating the facility.
- TFTR Authorization Basis for D-T Operations
 - DOE approved Hazard Classification: Category 3 (Low Hazard), having potential for only local consequences: based on tritium inventory (50 kCi) being < Category 2 threshold (300 kCi).
 - Amended FSAR (annual amendments approved by DOE were required).
 - **◆** DOE approved Environmental Assessment for NEPA compliance.
 - DOE approved Technical Safety Requirements (TSRs); administrative limits: (1) ≤50kCi in-process tritium onsite, & (2) ≤25 kCi tritium releasable in any credible accident analyzed in the FSAR.
 - DOE Safety Evaluation Report (SER) documenting their review & acceptance of the FSAR.
 - Unreviewed Safety Question Determinations (USQDs) to determine if a proposed facility physical or operational change, or new information on previous safety analyses, impacts the approved Authorization Basis. 630 USQDs were written from 1993-2001.

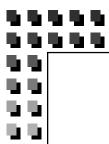


SPECIAL STUDIES SUPPORTING THE AUTHORIZATION BASIS

- Site Specific Climatology Study
 - Prior to 1988, offsite radiation dose calculations used standard Gaussian diffusion models based on open terrain sites.
 - Standard models underestimate atmospheric dilution for sites like PPPL where sources of release are located in complex of buildings and trees. Building & trees generate turbulence.
 - NOAA designed and conducted field tests in 1988 using gaseous tracers and meteorological measurements to characterize source strength concentrations (X/Qs) at 98 sampling sites within 1 km of TFTR. Releases from the D-Site stack and 3 ground level locations were simulated.
 - Results showed much greater effluent dilution than predicted by Gaussian models, up to a factor of 16 for 99.5% X/Q.

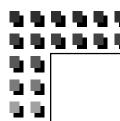






SPECIAL STUDIES SUPPORTING THE AUTHORIZATION BASIS

- Seismic Adequacy Analysis
 - In 1988 & 1992-93, a contractor verified the seismic adequacy of tritium bearing and certain other equipment in the TFTR experimental areas (piping, mechanical & electrical equipment, architectural features, cable trays, and HVAC systems).
 - Objective: to ensure that components containing tritium would not be breached in a design basis earthquake (Most Intense Earthquake, MIE).
 - Analysis used "seismic experience methodology" endorsed by the NRC. Uses data base of equipment at nuclear plants, fossil plants and commercial facilities that have performed well during strong ground motion earthquakes around the world.
 - Methodology evaluates (1) if TFTR equipment is similar to equipment in the data base; (2) if the data base earthquake motion envelopes the MIE; and (3) if the data base equipment performed well in the earthquake. If these are all true, then, with certain restrictions (e.g., adequate anchorage), the evaluated TFTR equipment is seismically qualified.
 - Contractor walked down the areas & identified where modifications were needed, PPPL made recommended changes, and contractor verified the adequacy of installed changes.
 - Seismic verification work was completed in June 1993, several months before D-T operations commenced.



SPECIAL STUDIES SUPPORTING THE AUTHORIZATION BASIS

- Uranium Bed Air Ingress Tests
 - Ontario Hydro Research Division conducted tests to investigate the response of uranium storage beds for tritium to ingress of air.
 - * Results:
 - Air ingress to TFTR storage bed at ambient or (elevated) operating temperatures would cause a modest (non-damaging) temperature increase of the bed.
 - No tritium would be released.



